## REMARKS

This amendment is in response to the Office Action dated March 2, 2006. Reconsideration of the above-identified application in view of the amendments above and the following remarks is respectfully requested.

Claims 1-19 are currently pending in the application.

### *Claims Objection*

Claims 5-6 are objected under U.S.C. 102(e) based on missing antecedent.

The Examiner argued, in his objection, that the term "*neural network parts*" does not appear in the original main claim that claims 5 and 6 are depended on. The original main claim (Claim 1) defines only the singular form of the wording ("*neural network part*").

In the light of the Examiner's remarks and according to the application description, the Applicant has amended independent claims 1 and dependent claims 5, 6, 7, 16, and 17 to define "*at least one neural network part*" which clearly define one, or more than one, *neural network parts*. The description of the present application defines more than one part or area as areas of interest for, *inter alia*, "*finding a first thresholder for thresholding gradients*", as clearly defined in paragraph [0016] and [0017] of the description. Paragraph [0042] of the description explicitly discloses the usage in number of *neural network parts*. The disclosure defines that "*neural network is a universal approximator that learns from the past to predict future values. It receives, in some form, as input certain areas of interest of a present stage, and predicts areas of interest for the next stage*". Since *different areas of interest* may be defined in different parts of the neural network, it is clear that one or more parts of the neural network are involved. In order to further emphasize the capability of the apparatus to rely on more than one neural network parts, it should be mentioned that more than one neural network may be used by the apparatus for calculating numerical solutions for partial differential equations (PDEs) in successive intervals, as describe in paragraph [0048].

### *Rejections under 35 USC 103(a)*

Claims 1 – 8, 10 – 15, and 17 - 19 are rejected under U.S.C. 103(a) as being unpatentable over Manevitz et al. article, Finite element Mesh Generation Using Self-Organizing Neural Networks, Computer-Aided Civil & Infrastructure Engineering, July 1997, Vol. 12 Issue 4, page 233 (hereinafter *Manevitz*) in view of Chedid et al. article, IEEE

Transaction on magnetics: Automatic finite element mesh generation using artificial neural networks: Part I—Prediction of mesh density Vol. 32, No. 5, September 1996 (hereinafter: *Chedid*).

The applicant believes that *Manevitz* in view of *Chedid* does not render obvious all limitations of the amended independent claims 1 and 18.

In the light of the Examiner's remarks, and according to the differences between *Manevitz* and *Chedid* and the present invention, the Applicant has amended independent claims 1 and 18, emphasizing the inventiveness of the present invention in the light of the prior art. Thus, the Applicant asserts that the amended claims 1 and 18 are allowable main claims, and that claims 2-17 and 19 are consequently allowable as being dependent on an allowable main claims.

In his response, the Examiner argues that *Manevitz* teaches "*an apparatus for calculating numerical solutions for partial differential equations in successive intervals using adaptive meshes*". The Examiner admits that *Manevitz* does not teach "*using a neural network to produce predictions of values of a parameter following interval based on values of said parameter available from previous intervals*".

The applicant submits that *Manevitz* indeed teaches an apparatus for calculating numerical solutions for PDEs in successive intervals. However, *Manevitz* teaches apparatus that uses meshes, which are static, their placement is based on geometric sampling, and not dynamic meshes that adjusted according to predication of a time series, as described below.

As quoted by the Examiner, *Manevitz* addresses the problem of mesh placement of a finite element mesh. The mesh that he uses is static and has to meet certain limitations, such as being finer in regions with large gradients (*Manevitz:* subsection 1). However, in *Manevitz* the gradients are neither calculated nor predicted their, but implicitly assumed based on geometric sampling.

Contrary, the present invention newly amended claim 1 addresses the problem of predicting gradients in time dependent neural networks. As disclosed in claim 1 the apparatus of the present invention is configured for adapting "*a dynamic mesh over a domain of a respective partial differential equation using predictions*". The problem, which is solved using the present invention method and apparatus, is not addressed in the prior art and requires the ability to handle dynamic data. The present invention is configured for using values which accumulate during the learning process for estimating future gradients. In every time interval, the invention as claimed allows the prediction of at least one gradient from a series of past values. It is this predicted future value of the gradient that is used as the refinement criteria for the finite element dynamic mesh (Present Invention: paragraph [0072]).

*Manevitz*, on the other hand, does not employ any prediction method. The article

relates to a static mesh generator that is based on the fixed geometry of a static body. Cleary, the apparatus, which is disclosed in the amended claim 1, and the method, which is disclosed in the amended claim 18 explicitly, defines dynamic meshes which are not disclosed in the prior art citation. The cited article rather addresses a different problem that relates to static data. Moreover, it should be noted that the data which is analyzed in Manevitz, is fixed geometric information. In the present invention by contrast, the data that is analyzed comprises dynamic values, which have been calculated in previous time intervals.

Additionally, it should be noted that *Manevitz* is focused on describing the desiderata for a mesh which fits a certain object having predefined geometric characteristics. *Manevitz* does not describe any method or an apparatus that allows the adapting of a mesh, certainly not a mesh that adaptively refines itself over successive intervals.

The Examiner further argues that in the light of *Chedid*, it would be obvious for one of ordinary skill in the art at the time of the applicant's invention to have combined *Manevitz's* neural network approach of "*a finite element method (FEM) application for solving partial differential equations (PDEs)*" with the predictive feed-forward neural network of *Chedid*.

The applicant submits that *Chedid* teaches a finite element method (FEM) for meshes. However, *Chedid's* article, as *Manevitz's* article, is also related to static mesh generation techniques. As described in the abstract of *Chedid's* article, *the essence of this technique is to predict the mesh density distribution of a given model.* Clearly, *Chedid*, like *Manevitz*, does not use or hint at a method that allows the dynamic generation of gradients from a series of past values, as defined in amended claims 1 and 18. Contrary to the present invention that uses neural networks for predication, which is based upon dynamic information, *Chedid* uses neural networks to predict mesh density according to static geometric features.

Therefore, the applicant believes that combining the predictive behavior of *Chedid's* Artificial Neural Network (ANN), which is based upon static information, with *Manevitz's* method, which is related to static meshes, does not render obvious for one of ordinary skill in the art at the time of the invention "*adapting a dynamic mesh over a domain of a respective partial differential equation using the predictions*", as described in claim 1.

Moreover, both *Manevitz* and *Chedid* describe geometric meshing of objects. Therefore, none of them is configured or adapted for predicting gradients based on time series predictions.

It could also be noted that even when *Chedid* refers *Kohonen networks*, which are self-organizing maps for unsupervised learning mechanism, it refers to a future article that has never been published.

In order to establish a *prima facie* case of obviousness, the prior art references when combined must teach or suggest all the amended claims limitations (*In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)*). The prior-art references, as elaborated above, do not

teach or suggest the apparatus and method, which are defined in the amended claim 1 and 18 that enables the adapting of a dynamic mesh over dynamic predictions that are derivatives of variable information. Therefore, no *prima facie* case of obviousness is established regarding the limitations of the amended claims 1 and 18.

Moreover, since neither *Manevitz* nor *Chedid* expressly or impliedly suggest the claimed invention, the applicant believes that no convincing line of reasoning exists at to why the artisan would have found a method that enables the adapting of a dynamic mesh over a domain of a respective PDE using predictions, such that the dynamic mesh adaptively refines itself about emerging regions of complexity as the PDE progresses over the successive intervals has been presented (*Ex parte Clapp, 227 USPQ 972, 973 (Bd. Pat. App. & Inter. 1985).*

Another criterion for establishing a prima facie case of obviousness is that there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. (*Ex parte Skinner, 2 USPQ2d 1788 (Bd. Pat. App. & Inter. 1986*) In the light of the above it should be noted that the motivation to combine the teachings of *Manevitz* and *Chedid* that relates to the generation of static meshes, in order to create an apparatus for calculating numerical solutions for PDEs in successive intervals using adaptive dynamic meshes is not apparent, as even when combined they do not provide adaptive dynamic meshes. As described above, the aims of *Manevitz* and *Chedid*, which describe techniques for generation of static meshes, are different from the aims of the present system. Therefore, there is no apparent motivation to change these techniques to an apparatus and method for calculating numerical solutions using adaptive dynamic meshes. Thus, no suggestion or motivation to make the present invention is found in the prior art.

In order to emphasize the innovation of the present invention, it should be noted that the scientific community has very well received the essences of the claimed apparatus. The Sixth Online World Conference on Soft Computing in Industrial Applications gave its "premier Best Paper Award" to the inventors for an article entitled "Finite Element Mesh Adaptation via time Series Prediction Using Neural Networks". This article, which was published in December 2001, is the basis for the limitation of claim 1 and claim 18. As quoted in the conference website (http://www.cec.uchile.cl/~wsc6/) the article was defined as an "*Excellent scientific work, which is...an engineering one... because time-dependent partial differential equations are the basic instrument for analyzing time-varying data sets which are typical for industrial applications* ". The article was also described as a paper that "*presents a nicely and well-written application of neural networks to solve the problem of mesh adaptation for the finite-element method for solving time-dependent partial differential equations*". Such reactions indicate on a breakthrough in the field which was not obvious to

the skilled man in the art.

In addition, the leading journal neurocomputing published an article by the inventors based on these ideas finite element mesh adaptation.

Claims 1 and 18, which were rejected under 35 USC 103(a) as unpatentable over *Manevitz* in view of *Chedid* are thus believed to be allowable for time depended partial differential equation via time series prediction using neural networks (Volume 26, 2005, Page 447-463).

Thus, if the reasons outlined above. Claims 2 – 17 and 19 are believed to be allowable as being dependent on an allowable main claim.

All of the issues raised by the Examiner have been dealt with. In view of the foregoing, it is submitted that all the claims now pending in the application are allowable over the cited reference. An early Notice of Allowance is therefore respectfully requested.

Respectfully submitted,

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***Encl.:***
Petition for Extension (1 Month)